

Short Biography:

Prof. Román was born in Mexico City, Mexico. He obtained his Bachelor of Science degree in Chemical Engineering at the University of Pennsylvania in 2002 and completed his Ph.D. at the University of Wisconsin-Madison, also in Chemical Engineering, under the guidance of Prof. James Dumesic. At UW he worked on developing catalytic strategies to convert biomass-derived carbohydrates into platform chemicals. Before joining the department of Chemical Engineering at MIT as an Assistant Professor, he completed a two-year postdoc at Caltech, working with Prof. Mark E. Davis on the synthesis of zeolites and mesoporous materials for the activation of small molecules and biomass-derived oxygenates. Prof. Roman's has been awarded the SHPE Outstanding Young Investigator and the NSF CAREER awards.

Prof. Román's research lies at the interface of heterogeneous catalysis and materials design. His group applies a wide range of synthetic, spectroscopic, and reaction engineering tools to study the chemical transformation of molecules on catalytic surfaces. A strong emphasis is placed on the application of catalytic materials to tackle relevant problems associated with sustainable energy, biofuels, and renewable chemicals. Current efforts are geared toward designing water-tolerant solid Lewis acids, investigating cooperative effects of catalytic pairs, and engineering transition metal carbides and nitrides as replacements for PGMs.

YURIY ROMÁN-LESHKOV

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Education

- Ph.D.** Chemical Engineering, University of Wisconsin-Madison, Madison, WI, **2008**
Advisor: James A. Dumesic. Thesis title: "Synthesis of furan compounds by liquid-phase catalytic processing of biomass-derived carbohydrates"
- B.S.** Chemical Engineering, University of Pennsylvania, Philadelphia, PA, **2002**

Professional Experience

- Assistant Professor of Chemical Engineering, MIT **2010-Present**
Postdoctoral Fellow, California Institute of Technology (Mark E. Davis) **2008-2010**
Materials Engineer, Federal Mogul Systems Protection Group **2002-2003**

Research Interests

- Heterogeneous catalysis, renewable energy, design of functional nanomaterials, biomass conversion, activation of small molecules, zeolite synthesis.

Awards and Honors

- NSF Career Award **2014**
- Outstanding Young Investigator Award SHPE Foundation **2013**
- Elected vice-chair for the New England Catalysis Society **2013-2016**
- Texaco-Mangelsdorf Career Development Chair **2010-2013**
- Gordon Research Conference – Catalysis Best Poster Award **2008**
- Carl Storm Fellowship – Gordon Research Conference **2008**
- Kokes Travel Award – North American Catalysis Society **2007**
- R. A. Ragatz Award for Best Teaching Assistant **2004 & 2006**
- Melvin C. Molstad Prize **2002**
- Hexagon Honors Society **2001**

Publications (* denotes corresponding author)

From independent career:

- 36) Abdelrahman, O. A., Luo, H. Y., Heyden, A., **Román-Leshkov, Y.** & Bond, J.
Towards rational design of stable, supported metal catalysts for aqueous phase processing: insights from the hydrogenation of levulinic acid
J. Catal. *Submitted* February (2015).
- 35) Hunt, S., Kokumai, T., Zanchet, D., & **Román-Leshkov, Y.***
Bimetallic Tantalum Tungsten Carbide Nanoparticles Exhibit High Hydrogen Evolution Activity and Increased Electrochemical Oxidation Resistance
Chem. Mat. *Submitted* January 2015.
- 34) Wright, M., Seifkar, N., Green, W. H., & **Román-Leshkov, Y.***
Natural Gas and Cellulosic Biomass: a Clean Fuel Combination? Determining the Natural Gas Blending Wall in Biofuel Production
Environ. Sci. Technol. *Submitted* January 2015.

- 33) Wang, Y., Vogelgsang, F., & **Román-Leshkov, Y.***
Acid-catalyzed oxidation of levulinate derivatives to succinates under mild conditions
ChemCatChem Accepted DOI: 10.1002/cctc.201403014R1 (2015).
- 32) Said, S. A., Simakov, D. S., Mokheimer, E. M., Habib, M. A., Ahmed, S., Waseeuddin, M., & **Román-Leshkov, Y.**
Computational fluid dynamics study of hydrogen generation by low temperature methane reforming in a membrane reactor
Int. J. Hydrogen Energy In Press DOI:10.1016/j.ijhydene.2015.01.024 (2015).
- 31) Van de Vyver, S., Odermatt, C., Romero, K., & **Román-Leshkov, Y.***
Solid Lewis Acids Catalyze the Carbon–Carbon Coupling of Biomass-Derived Molecules with Formaldehyde
ACS. Catal. 5:972–977 (2015).
- 30) Narsimhan, K., Michaelis, V. K., Mathies, G., Gunther, W. R., Griffin, R. G., & **Román-Leshkov, Y.***
Production of Acetic Acid from Methane via Tandem Oxidation and Carbonylation on Copper Exchanged Mordenite Zeolites
J. Am. Chem. Soc. Article ASAP DOI: 10.1021/ja5106927 (2015).
- 29) Simakov, D. S., Wright, M., Ahmed, S., Mokheimer, E. M., & **Román-Leshkov, Y.***
Solar thermal catalytic reforming of natural gas: a review on chemistry, catalysis and system design
Catal. Sci. Technol. Early view DOI: 10.1039/C4CY01333F (2015).
- 28) Luo, H., Consoli, D., Gunther, W. R., & **Román-Leshkov, Y.***
Investigation of the reaction kinetics of isolated Lewis acid sites in Beta zeolites for the Meerwein-Ponndorf-Verley reduction of methyl levulinate to γ -valerolactone
J. Catal. 320:198–207(2014).
- 27) Crisci, A. J., Dou, H., Prasomsri, T., & Román-Leshkov, Y.
Cascade Reactions for the Continuous and Selective Production of Isobutene from Bio-derived Acetic Acid Over Zinc-Zirconia Catalysts
ACS. Catal. 4:4196-4200 (2014).
- 26) Bruijninx, P. C. A.,* & **Román-Leshkov, Y.***
Sustainable catalytic conversions of renewable substrates.
Catal. Sci. Technol. 4:2180-2181 (2014).
- 25) Lewis, J. D., Van de Vyver, S., Crisci, A. J., Gunther, W. R., Michaelis, V. K., Griffin, R. G., & **Román-Leshkov, Y.***
A Continuous Flow Strategy for the Coupled Transfer Hydrogenation and Etherification of 5-(Hydroxymethyl)furfural using Lewis Acid Zeolites.
ChemSusChem 7:2255–2265 (2014).
- 24) Gunther, W.R., Michaelis, V.K., Caporini, M. A., Griffin, R.G., & **Román-Leshkov, Y.***
Dynamic nuclear polarization NMR enables the analysis of Sn-Beta zeolite prepared with natural abundance ^{119}Sn precursors.
J. Am. Chem. Soc. 136:6219-6222 (2014).
- 23) Prasomsri, T., Shetty, M., Murugappan, K., & **Román-Leshkov, Y.*** Insights into the catalytic activity and surface modification of MoO_3 during the hydrodeoxygenation of lignin-derived compounds into aromatic hydrocarbons under mild conditions.
Energy Environ. Sci. 7:2660-2669 (2014). (Selected for back cover)
- 22) Hunt, S. T., Nimmanwudipong, T. & **Román-Leshkov, Y.*** Engineering Non-sintered, Metal-terminated Tungsten Carbide Nanoparticles for Catalysis
Angew. Chem. Int. Ed. 53:5131-5136 (2014).

- 21) Wang, Y., Van de Vyver, S., Sharma, K. K., & **Román-Leshkov, Y.*** Insights into the stability of gold nanoparticles supported on metal oxides for the base-free oxidation of glucose to gluconic acid.
Green Chem. 16:719-726 (2014).
- 20) Gunther, W. R., Duong, Q., & **Román-Leshkov, Y.*** Catalytic consequences of borate complexation and pH on the epimerization of L-arabinose to L-ribose in water catalyzed by Sn-Beta zeolite with borate salts.
J. Mol. Catal. A: Chem. 379:294-302 (2013).
- 19) Bui, L., Luo, H., Gunther, W.R. & **Román-Leshkov, Y.*** Domino reaction for the production of gamma-valerolactone from furfural catalyzed by zeolites with Brønsted and Lewis acid sites.
Angew. Chem. Int. Ed. 52:8022-8025 (2013). (Hot Article and Inside Cover)
- 18) Prasomsri, T., Nimmanwudipong, T. & **Román-Leshkov, Y.*** Effective hydrodeoxygenation of biomass-derived oxygenates into unsaturated hydrocarbons by MoO₃ using low H₂ pressures.
Energy Environ. Sci. 6:1732-1738 (2013). (Inside Cover)
- 17) Van de Vyver, S. & **Román-Leshkov, Y.*** Emerging catalytic processes for the production of adipic acid.
Catal. Sci. Technol. 3:1465-1479 (2013).
- 16) Van de Vyver, S., Helsen, S., Geboers, J., Yu, F., Thomas, J., Smet, M., Dehaen, W., **Román-Leshkov, Y.**, Hermans, I., & Sels, B.F. Mechanistic Insights into the Kinetic and Regiochemical Control of the Thiol-Promoted Catalytic Synthesis of Diphenolic Acid.
ACS Catal. 2:2700-2704 (2012).
- 15) Luo, H. Y., Bui, L., Gunther, W.R., Min, E. & **Román-Leshkov, Y.*** Synthesis and catalytic activity of Sn-MFI Nanosheets for the Baeyer-Villiger oxidation of cyclic ketones.
ACS Catal. 2:2695-2699 (2012).
- 14) Gunther, W.R., Wang, Y., Ji, Y., Michaelis, V.K., Hunt, S.T., Griffin, R.G., & **Román-Leshkov, Y.*** Sn-Beta zeolites with borate salts catalyse the epimerization of carbohydrates via an intramolecular carbon shift.
Nat. Commun. 3:1109-1115 (2012).
- 13) Wright, M.M., Green, W.H. & **Román-Leshkov, Y.*** Investigating the techno-economic tradeoffs of hydrogen source using a response surface model of drop-in biofuel production via bio-oil upgrading.
Biofuels, Bioprod. Biorefin. 6:503-520 (2012).
- 12) Zahmakıran, M., Zhang, Y. & **Román-Leshkov, Y.*** Rhodium(0) Nanoparticles Supported on Nanocrystalline Hydroxyapatite: Highly Effective Catalytic System for the Solvent-Free Hydrogenation of Aromatics at Room Temperature.
Langmuir 28:60–64 (2012).

Doctoral and postdoctoral research:

- 11) Bermejo-Deval, R., Assary, R.S, Nikolla, E., Moliner, M., **Román-Leshkov, Y.**, Huang, S.J., Palsdottir, A., Silverman, D., Lobo, R.F., Curtiss, L., & Davis, M.E. Metalloenzyme-like catalyzed isomerizations of sugars by Lewis acid zeolites.
Proc. Nat. Acad. Sci. 109:9727-9732 (2012).
- 10) **Román-Leshkov, Y.** & Davis, M. E. Activation of Carbonyl-Containing Molecules with Solid Lewis Acids in Aqueous Media.
ACS Catal. 1:1566–1580 (2011).
- 9) Nikolla, E., **Román-Leshkov, Y.**, Moliner, M. & Davis, M. E. “One-Pot” Synthesis of 5-(Hydroxymethyl)furfural from Carbohydrates using Tin-Beta Zeolite.
ACS Catal. 1:408-410 (2011).

- 8) **Román-Leshkov, Y.**, Moliner M. & Davis, M.E. Impact of controlling the site distribution of Al atoms on catalytic properties in ferrierite-type zeolites. *J. Phys. Chem. C* 115:1096-1102 (2011).
- 7) **Román-Leshkov, Y.**, Moliner M., Labinger J. & Davis, M.E. Mechanism of Glucose Isomerization Using a Solid Lewis Acid Catalyst in Water. *Angew. Chem. Int. Ed.* 49:8954-8957 (2010).
- 6) Moliner M., **Román-Leshkov, Y.**, & Davis, M.E. Tin-containing Zeolites are Highly Active Catalysts for the Isomerization of Glucose in Water. *Proc. Natl. Acad. Sci. U.S.* 107:6164-6168 (2010).
- 5) **Román-Leshkov, Y.**, Moliner M. & Davis, M.E. Hybrid, organic-inorganic solids that show shape selectivity. *Chem. Mat.* 22:2646 (2010).
- 4) **Román-Leshkov, Y.** & Dumesic, J. A. Solvent Effects on Fructose Dehydration to 5-Hydroxymethylfurfural in Biphasic Systems Saturated with Inorganic Salts. *Top. Catal.* 52:297-303 (2009).
- 3) **Román-Leshkov, Y.**, Barrett, C. J., Liu, Z. Y. & Dumesic, J. A. Production of dimethylfuran for liquid fuels from biomass-derived carbohydrates. *Nature* 447:982-985 (2007).
- 2) Chheda, J. N., **Román-Leshkov, Y.** & Dumesic, J. A. Production of 5-hydroxymethylfurfural and furfural by dehydration of biomass-derived mono-and poly-saccharides. *Green Chem.* 9:342-350 (2007).
- 1) **Román-Leshkov, Y.**, Chheda, J. N. & Dumesic, J. A. Phase modifiers promote efficient production of hydroxymethylfurfural from fructose. *Science* 312:933-1937 (2006).

Patents

- Román-Leshkov, Y.* & Hunt, S. T. "A process for the production of non-sintered transition metal carbide and nitride nanoparticles" United States Patent Application No. 61/862,514
- Román-Leshkov, Y.* & Dou, H. "Highly active oxide catalysts for the catalytic ketonization of carboxylic acids" United States Patent 8748670.
- Davis, M.E., Moliner M., & Román-Leshkov, Y. "New Catalysts for the Isomerization of Sugars" United States Patent 8729256.
- Dumesic, J.A., Román-Leshkov, Y., & Chheda, J. N. "Catalytic process for producing furan derivatives in a biphasic reactor" United States Patent 7572925.
- Dumesic, J.A. & Román-Leshkov, Y. "Production of liquid alkanes in the jet-fuel range (C₈-C₁₅) from biomass-derived carbohydrates" United States Patent 7880049.
- Frederick, M.P., Staudt, E. K., Román-Leshkov, Y., & Barber Jr., J. A. "Multi-branch junction overwrap" United States Patent 6960722.

Book Chapters

- Brown, T., Wright, M., Román-Leshkov, Y., & Brown, R. (2014). Techno-economic assessment (TEA) of advanced biochemical and thermochemical biorefineries. *Advances in Biorefineries: Biomass and Waste Supply Chain Exploitation*, 34.
- Gürbüz, E., Bond, J. Q., Dumesic, J. A., & Román-Leshkov, Y. (2013). Chapter 8. Role of acid catalysis in the conversion of lignocellulosic biomass to fuels and chemicals. *The Role of Catalysis for the Sustainable Production of Bio-fuels and Bio-chemicals*, 261-288.

Professional Service

- Vice-chair of the New England Catalysis Society
- Programming Chair of the AIChE Catalysis and Reaction Engineering Division
- Conference chair and symposium organizer in ACS and AIChE
- Reviewer for Nature Communications, Nature Chemistry, Angewandte Chemie Int. Ed., JACS, Energy and Environmental Science, ChemSusChem, Journal of Catalysis, ACS Catalysis.
- Founding member of “The Initiative for a Carbon Negative Economy” (ICNE).
- Guest editor for Journal of Molecular Catalysis and Catalysis Science and Technology.
- Associate Housemaster at Ashdown House in MIT.